COMPLETE SYLLABUS OF TECHNICAL GENERAL IS AS FOLLOWS

Aircraft and Engines

1.1 Airframe and Systems

Fuselage – types of construction – stress – Wings – types of construction – structural components – stress – Stabilizing surfaces – vertical, horizontal and V-tail surfaces – 'flutter' – compensation system – mach trim – Landing Gear – types – locking devices and emergency extension systems – accidental retraction prevention devices – position, movement lights and indicators – nose wheel steering – wheels and tyres (limitations) – braking systems – parking brake – mode of operation of anti-skid system – mode of system of auto brake system – operation, indications and warning systems – Flight Controls – Primary controls: – elevator, aileron and rudder – trim – mode of actuation (mechanical, hydraulic, electrical, fly-bywire) – operation, indicators, warning devices and controls) – efforts to transmit – Secondary controls: – leading and trailing edge lift augmentation devices – lift dumping and speed brakes – variable elevator – mode of actuation (mechanical, hydraulic, electrical, fly-bywire) – operation, indicators, warning devices and controls) – danger situations and potential failures – Hydraulics – Basic principles of hydromechanics – hydraulic fluids – schematic construction and functioning of hydraulic systems – Hydraulic system – main, standby and emergency system – operation, indicators, warning system – ancillary system – Pneumatic system – power sources – schematic construction – potential failures, warning devices – operation, indicators, warning systems – pneumatic operated systems – Air-conditioning systems – construction, functioning, operation, indicators and warning devices – heating and

cooling – temperature regulation – automatic and manual – ram air ventilation – schematic construction – Anti-ice systems – aerofoil and control surfaces, power plant, air intakes, windshield – schematic construction, operating limitations and initiation, timing of de-icing system usage – ice warning system – Pressurization – cabin altitude, maximum cabin altitude, differential pressure – pressurized zones in the aircraft – safety devices and warning systems – rapid decompression, cabin altitude warning – emergency procedures – Non-pneumatic operated de-ice and anti-ice systems – schematic construction, functioning and operation of: – air intake – propeller-pitot, static pressure sensor and stall warning devices – windshield – rain repellent system – Fuel system – Fuel tanks – structural components and types – location of tanks on single-and-multi-engine aircraft – sequence and types of re-fuelling – unusable fuel – Fuel feed – gravity and pressure feed – crossfeed – Fuel system monitoring – operating, indicators, warning systems – fuel management (sequencing of fuel tank switching) – dip stick

1.2 Electrics

a) Director Current (DC)

Direct /Alternating Current (DC/AC) – General – electric circuits – voltage, current, resistance – Ohm's law – resistive circuits – resistance as a function of temperature – electrical power, electrical work – fuses (function, type and operation) – the electrical field – the capacitor (function) system, shock absorbers) Batteries – types, characteristics – capacity – uses – hazards – Magnetism – permanent magnetism – electromagnetism: – relay, circuit breaker, solenoid valve (principle, function and applications) – electromagnetic power – electromagnetic induction – Generators – alternator: – principle, function and applications – monitoring devices – regulation,

control and protection – modes of excitation – starter generator – Distribution – current distribution (buses) – monitoring of electrical flight instruments/systems: – ammeter, voltmeter – annunciators – electrical consumers – DC power distribution: – construction, operation and system monitoring – elementary switching circuits – Inverter – The aircraft structure as an electrical conductor b) Alternating Current (AC) – General – single and multi-phase AC – frequency – phase shift – AC components – Generators – 3-phase generator – brushless generator – generator drive: – constant speed drive – integrated drive – AC power distribution – operation and monitoring – protection circuits, paralleling of Ac-generators – Transformers – function – types and applications – Transformer/rectifier units d) Basic knowledge of computers – Logic circuits – Logical symbols – Switching circuits and logical symbols

1.3 Power Plant

a) Piston engine General

design type – Principle of the 4-stroke internal combustion engine – Mechanical component Lubrication system – function – schematic construction – monitoring instruments and indicators – lubricants Air cooling – system monitoring – cylinder head temperature – cowl flaps Ignition – schematic construction and function – types of ignition – magneto check Engine fuel supply – carburetor (construction and mode of operation, carburetor icing) – fuel injection (construction and mode of operation) – alternate air Engine performance – pressure / density altitude – performance as a function of pressure and temperature Power augmentation devices – turbocharger, supercharger (construction and effect on engine performance) Fuel – types, grades – detonation characteristics, octane rating – colour coding – additives – water content, ice formation – fuel density – alternate fuels, differences in specifications, limitations

Mixture – rich and lean mixture – maximum power and fuel economy mixture setting Propeller – fixed pitch and constant speed propeller – principles and operation of propellers on single and multi-engine aircraft – propeller check – propeller efficiency as a function of airspeed – aircraft and engine protection (propeller operation: ground/ air, coarse/fine pitch limitations) Engine handling and manipulation – power setting, power range – mixture setting – operational limitations Operational criteria – maximum and minimum RPM – (induced) engine vibration and critical RPM – remedial action by abnormal engine start run-up and inflight

b) Turbine engine

principles of operation – types of construction – turboprop – turbojet – turbofan

c) Engine construction

Air inlet – function – Compressor – function – construction and mode of operation – effects of damage – compressor stall and surge (cause and avoidance) – Diffuser – function – Combustion chamber – function, types and working principles – mixing ratios – fuel injectors – thermal load – Turbine – function, construction and working principles – thermal and mechanical stress – effects of damage – monitoring of exhaust gas temperature – Jet pipe – function – different types – noise silencing devices – Pressure, temperature and airflow in a turbine engine – Reverse thrust – function, types and principles of operation – degree of efficiency – use and monitoring – Performance and thrust augmentation – water injection, principles of operation – use and system monitoring – Bleed air – effect of use of bleed air on thrust, exhaust temperature, RPM and pressure ratio – Auxiliary gearbox – function

d) Engine systems

Ignition – function, types, components, operation, safety aspects – Starter – function, type, construction and mode of operation – control and monitoring – self sustaining and idle speeds – Engine start malfunctions – cause and avoidance – Fuel system – schematic diagrams, components – operation and monitoring – malfunctions – Lubrication – components – operation and monitoring – malfunctions – Fuel – effects of temperature – impurities – additives – Thrust – thrust formula – flat rated engine – thrust as a function of airspeed, air density, pressure, temperature and RPM – power plant operation and monitoring e) Auxiliary Power Unit (APU) – General – function, types – location – operation and monitoring – Ram air turbine – function

1.4 Emergency Equipment

a) Doors and emergency exits

evacuation slides, general usage or as life rafts or flotation devices

b) Smoke detection

location, indicators, function test

c) Fire detection

location, warning mode, function test

d) Fire fighting equipment

location, operation, contents, gauge, function test

e) Aircraft oxygen equipment

drill, use of equipment in case of rapid decompression – oxygen generators

f) Hydraulic systems

components, fluids – operation, indication, warning systems – auxiliary systems g) Emergency equipment – portable, hand-held fire extinguisher – smoke mask, smoke protection hood] – portable oxygen system – emergency locator beacon, transmitter – life jacket, life raft – pocket lamp, emergency lighting – megaphone – cash axe – fireproof gloves – emergency flotation system

Principles of Flight

a) Basics Laws and Definitions

Laws and definitions

units – laws of Newton – ideal gas equation – equation of impulse – equation of continuity – Bernoulli's theorem – static pressure – dynamic pressure – viscosity – density – IAS, CAS, EAS, TAS – Basics about airflow – stationary airflow – not stationary airflow – streamline – stream tube – two-dimensional airflow – three-dimensional airflow – Aerodynamic forces on surfaces – resulting air force – lift – drag – angle of attack – forces and equilibrium of forces during climb, level, descent and turn – Shape of an aerofoil – thickness of chord ratio – chordline – camberline – nose radius – camber – angle of attack – angle of incidence – The wing shape – aspect ratio – root chord – tip chord – tapered wings – shape of wing surface – mean aerodynamic chord (MAC)

b) The two-dimensional airflow about an aerofoil

streamline pattern – stagnation point – pressure distribution – centre of pressure – lift and downwash – drag and wake (loss of impulse) – influence of angle of attack – flow separation at high angles of attack – the lift-graph

c) The coefficients

The lift coefficient C – the lift formula – CL – α graph – CLmax and α – normal values of CLmax, αcrit, stall, and the slope of the CL / A.o.A curve – The drag coefficient CD – the drag formulas: – zero lift drag – lift induced drag – CD – α graph – CL – CD graph, profile polar – CL – CD ratio – normal values of the CL – CD ratio

d) The three-dimensional airflow about an aeroplane Streamline pattern

span-wise flow and causes – tip vortices and local α – tip vortices and angle of attack – up-wash and down-wash due to tip vortices – span-wise lift distribution – wake turbulence behind an aircraft (causes, distribution, duration of the phenomenon) – Induced drag – influence of tip vortices on the angle of attack – the induced local α – influence of induced angle of attack on the direction of the lift vector – induced drag and angle of attack – induced drag and speed – induced drag and wing aspect ratio – induced drag and wing planform – induced drag coefficient – induced drag coefficient and angle of attack – influence of the induced drag on the CL – α graph – influence of the induced drag on the CL – CD graph, airplane lift drag ratio – influence of plan of section – winglets – wing span loading – influence of wing twist

e) The total drag

influence of change of camber – the parasite drag – profile drag – interference drag – friction drag – The profile drag and speed – the induced drag and speed – the total drag – the total drag and speed – minimum drag – the drag – speed graph

f) The ground effect

effect on CDi – effect on αcrit – effect on CL – Effect on take-off and landing characteristics of an aircraft

g) The relation between the lift coefficient and the speed for constant lift

as a formula – in a graph

h) The stall

Flow separation at increasing angles of attack – the boundary layer: – laminar layer – turbulent layer – transition – separation point – influence of angle of attack – influence on: – pressure distribution – location of centre of pressure – CL – CD – pitch moments – down-wash at horizontal stabilizer – buffet – use of controls – The stall speed – in the lift formula – 1g stall speed – influence of: – the centre of gravity – power setting – altitude / IAS – wing loading – load factor n: – definition – turns – forces – The initial stall in span-wise direction – influence of plan form – aerodynamic twist (wash out) – geometric twist – use of ailerons – influence of fences, vortilons, saw teeth and vortex generators – Special phenomena of stall – the power-on stall – climbing and descending turns – swept back wings – super- or deep-stall, stick pusher – canards – T-tailed aircraft – avoidance of spins: – spin development – spin recognition – spin recovery – ice (in stagnation point and on surface): – absence of stall warning – abnormal behaviour of the stall – stabilizer stall – Stall warning – importance of stall warning – speed margin –

buffet – stall strip – flapper switch – AOA vane – AOA probe – stick shaker – recovery from stall

i) CLmax augmentation

Trailing edge flaps and the reasons for use in take-off and landing – different types of flaps: – split flap – plain flap- slotted flap – fowler flap – their influence on the CL – α graph – their influence on the CL – CD graph – flap asymmetry – influence on pitch movement – Leading edge devices and the reasons for use in take-off and landing – different types: – Krueger flaps – variable camber flaps – slats – their influence on the CL – α graph – their influence on the CL – CD graph – slat asymmetry – normal/automatic operation – Vortex generators – aerodynamic principles – advantages – disadvantages

j) Means to decrease the CL

CD ratio, increasing drag – Spoilers and the reasons for use in the different phases of flight – different functions: – flight spoilers (speedbrakes) – ground spoilers (lift dumpers) – roll spoilers – spoiler-mixer – their influence on the CL – α graph – their influence on the CL – CD graph and ratio – Speedbrakes as a means of increasing drag and the reasons for use in the different phases of flight – the influence on the CL – CD graph ratio

k) The boundary layer

Different types laminar – turbulent – Their advantages and disadvantages on pressure drag and friction drag

l) Special circumstances

Ice and other contamination – ice in stagnation point – ice on the surface (frost, snow, clear ice) – rain – contamination of the leading edge – effects on stall – effects on loss of controllability – effects on control surface movement – influence on high lift devices during take-off, landing and low speeds – affect on lift/drag ratio – Deformation and modification of airframe, ageing aircraft

2.2 Transonic Aerodynamics

The Mach number definition – speed of sound – influence of temperature and altitude – compressibility – Normal shockwaves – Mcrit and exceeding Mcrit – Influence of: – mach number – control deflection – angle of attack – aerofoil thickness – angle of sweep – area ruling – CL – α graph – CLmax – CD – CL – CD – Aerodynamic heating – Shock stall / Mach buffet – Influence on: – drag – pitch (Mach trim): – contribution of: – movement of the centre of pressure – angle of sweep – down-wash – Buffet margin, aerodynamic ceiling – Means to avoid the effects of exceeding Mcrit – Vortex generators – Supercritical profile – shape – influence of aerofoil shape on shockwaves – advantages and disadvantages of supercritical aerofoil

2.3 Stability

a) Condition of equilibrium in stable horizontal flight –

precondition for static stability – sum of moments – lift and weight – drag and thrust – sum of forces – in horizontal plane – in vertical plane

b) Methods of achieving balance

Wing and empennage (tail and canard) – control surfaces – Ballast or weight trim

c) Longitudinal stability

Basics and definitions – Static stability, positive, neutral and negative – precondition for dynamic stability – dynamic stability, positive, neutral and negative – damping:- phugoid – short period – effect of high altitude on dynamic stability – static stability – neutral point/location of neutral point – definition – Contribution of: – aircraft geometry – down-wash – a.c. of the wing – Location of centre of gravity – aft limit, minimum stability margin – forward position – effects on static and dynamic stability – The CM – α graph – Contribution of: – location of centre of gravity – control deflection – major aircraft parts (wings, fuselage, tail) – configuration: – flap deflection – gear extension – The elevator position – speed graph (IAS) – Contribution of; – location of centre of gravity – trim (trim tab) – trim (stabilizer trim) – Mach number/Mach trim – friction in the system – down spring – bob weight – The manoeuvring /stick force per g – Contribution of: – location of centre of gravity – trim – down spring – bob weight – Stick force per g and the limit load factor – category of certification – Special circumstances – ice: – effects of flap extension – effects of stabilizer ice – rain – deformation of airframe

d) Static directional stability

Slip angle ß – Yaw moment coefficient CN – CN – ß graph – Contribution of : – location of centre of gravity – angle of sweep of the wing – fuselage at high angles of attack – strakes – dorsal fin and angle of sweep of fin – major aircraft parts

e) Static lateral stability

Bank angle ø – The roll moment coefficient CL – Contribution of angle of slip ß – The CL – ß graph – Contribution of: – angle of sweep of wing – ventral fin – location of the wing – dihedral / anhedral – Effective lateral stability

f) Dynamic lateral stability

effects of asymmetric propeller slipstream – Tendency to spiral dive – Dutch roll – causes – Mach – yaw damper- Effects of altitude on dynamic stability

2.4 Control

a) General

Basics, the Three Planes and Three Axis – Camber change – Angle of attack change

b) Pitch Control

Elevator – Down-wash effects – Ice on tail – Location of centre of gravity

c) Yaw Control

Pedal/Rudder ratio changer – Moments due to engine thrust – direct – induced – Engine failure – rudder limitations at asymmetric thrust – meaning of VMCA, VMCG

d) Roll Control

Ailerons – inboard ailerons – outboard ailerons – function in different phases of flight – Spoilers – Adverse yaw – Means to avoid adverse yaw – frise ailerons – differential

aileron deflection – coupling ailerons to rudder by spring – roll spoilers – effects of asymmetric propeller slip stream

e) Interaction in different planes (yaw/roll)

limitations of asymmetric power 6

f) Means to reduce control forces

Aerodynamic balance – nose balance – horn balances – internal balances – balance tab, anti-balance tab – servo tab – spring tab – Artificial – power assisted controls – fully powered controls – artificial feel: – inputs: – dynamic pressure q – stabilizer setting

g) Mass Balance – reasons to balance – means h) Trimming

reasons to trim – trim tabs – stabilizer trim/trim rate versus IAS – position of centre of gravity influence on trim/stabilizer setting for take-off

2.5 Limitations

a) Operating limitations

flutter – aileron reversal – gear/flap operating – VMO, VNO, VNE – MMO

b) Manoeuvring envelope

Manoeuvring load diagram – load factor – accelerated stall speed – VA, VC, VD – manoeuvring limit load factor/certification category – Contribution of: – mass – altitude – Mach number

c) Gust Envelope

Gust load diagram – vertical gust speeds – accelerated stall speed – VB, VC, VD – gust limit load factor – VRA – Contribution of: – mass – altitude – Mach number

2.6 Propellers

a) Conversion of engine torque to thrust

meaning of pitch – blade twist – fixed pitch and variable pitch/constant speed – propeller efficiency versus speed – effects of ice on propeller

b) Engine failure or engine stop

Windmilling drag – influence on yaw moment when asymmetric power – Feathering – influence on glide performance – influence on yaw moment when asymmetric power

c) Design feature of power absorption

aspect ratio of blade – diameter of propeller – number of blades – propeller noise

d) Moments and couples due to propeller operation

Torque reaction – Gyroscopic precession – Asymmetric slipstream effect – Asymmetric blade effect

2.7 Flight Mechanics

a) Forces action on an airplane

Straight horizontal steady flight – Straight steady climb – Straight steady descent – Straight steady glide – Steady coordinated turn – bank angle – load factor – turn radius – angular velocity – rate one turn

b) Asymmetric Thrust

Moments about the vertical axis – Influence of bank angle – overbanking – finstall – Influence of aircraft weight – Influence of use of ailerons – Influence of special propeller effects on roll moments – propeller torque – propeller wash on flaps – Influence of slipangle on roll moments – VMCA – VMCL – VMCG – Influence of altitude

c) Emergency Descent

– Influence of configuration – Influence of chosen mach number and IAS – Typical points on polar curve

d) Windshear